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Simulated single-layer forest canopies delay snowmelt across boreal forests

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CMIP5 models have been shown to underestimate both trend and variability in Northern Hemisphere spring snow cover extent, a fifth of which is covered by boreal forests. Enhancement of longwave radiation beneath forest canopies has been found to impact the surface energy balance and rates of snowmelt. Although modelling skill for snowmelt has been shown to be lower for forested than for open areas, model intercomparisons and evaluations of model parameterizations have not yet focused on longwave enhancement and its impact on snow cover.
Models using single-layer vegetation schemes have been found to overestimate diurnal cycles in sub-canopy longwave radiation, with daytime overestimations and nighttime underestimations. Among those models is Community Land Model version 4.5 (CLM4.5), land component of Community Earth System Model that was part of CMIP5. This study derives a correction from forest stand-scale simulations of CLM4.5 in order to reduce diurnal cycles of sub-canopy longwave radiation, which is subsequently implemented for evergreen needleleaf trees in global simulations of CLM4.5. Nighttime underestimations of sub-canopy longwave radiation outweigh daytime overestimations, which leads to underestimated averages over the snow cover season. Consequently, snow temperatures are underestimated and snowmelt is delayed in CLM4.5 across evergreen boreal forests.